WHAT IS CLAIMED IS:

1. A quantum memory comprising:

a memory cell section of a plurality of memory cells, each of the plurality of the memory cells comprising a physical system ensemble, the physical system ensemble comprising physical systems configured to have a total angular momentum of magnetic sublevels, the physical system ensemble being configured to have quantum information expressed by a quantum state of whole amount of the total angular momentum of magnetic sublevels, the plurality of memory cells comprising two storage memory cells storing the quantum state and a transfer memory cell transferring the quantum state, and substantially strait line units each extending from an edge to another edge of the memory cell section and each consisting of one of the two storage memory cells and the transfer memory cell;

a magnet configured to apply a magnetic field to the two storage memory cells and the transfer memory cell;

a first light source configured to irradiate the two storage memory cells and the transfer memory cell with right-handed or left-handed polarized light;

a second light source configured to simultaneously irradiate the storage memory cell and the transfer memory cell of one of the substantially strait line units with a laser beam; and

a detector configured to detect a polarization state of the laser beam.

2. The quantum memory according to claim 1, wherein the memory cell is formed of a physical system ensemble distributed in a part of a space where an ensemble angular momentum is generated by selectively irradiating a spatially continuously and uniformly distributed substance with light, and the substance contains memory cells.

3. The quantum memory according to claim 1, wherein the physical system ensemble consists of gas atoms.

4. The quantum memory according to claim 1, wherein the physical system ensemble consists of rare earth ions in a solid.

5. The quantum memory according to claim 1, wherein the detector is a homodyne detector detecting cosine and sine components of a polarization state of the laser beam transmitted through the two memory cells at an angular frequency of Larmor precession.

6. The quantum memory according to claim 1, wherein the memory cells are arranged on a same plane at vertices and at a center of a regular polygon having an odd number of vertices, and wherein the memory cell arranged at the center of the regular polygon is used as the transfer memory cell and the memory cells arranged at the vertices of the regular polygon are

used as the storage memory cells.

7. The quantum memory according to claim 1, wherein the memory cells are arranged on a same circumference, and wherein a memory cell is used as the transfer memory cell and the other memory cells are used as the storage memory cells.

8. The quantum memory according to claim 1, wherein the storage memory cells are arranged on a same straight line, and wherein the transfer memory cell is arranged on a position off the straight line.

9. A quantum memory comprising:

memory cells each comprising a physical system ensemble, the physical system ensemble comprising physical systems configured to have a total angular momentum of magnetic sublevels, quantum information of the physical system ensemble being expressed by a quantum state of whole amount of the total angular momentum of the physical systems, and the memory cells including two storage memory cells storing the quantum state and a transfer memory cell transferring the quantum state, only two of the memory cells being present on a straight line;

a magnet configured to apply a magnetic field to the two storage memory cells and the transfer memory cell;

a first light source configured to irradiate the two storage memory cells and the transfer memory cell

with right-handed or left-handed polarized light;

a second light source configured to simultaneously irradiate one of the two storage memory cells and the transfer memory cell with a laser beam; and

a detector detecting a polarization state of the laser beam.

10. An information processing method using a quantum memory in which memory cells are provided, each of the memory cells being formed of a physical system ensemble, the physical system ensemble comprising physical systems configured to have a total angular momentum of magnetic sublevels, quantum information of the physical system ensemble being expressed by a quantum state of whole amount of the total angular momentum of the physical systems, at least one of the memory cells being used as a transfer memory cell A transferring the quantum state, memory cells other than the transfer memory cell A being used as storage memory cells storing the quantum state, and in which a set of two arbitrary memory cells V and B is selected from the storage memory cells and the quantum state of the memory cell V is transferred to the memory cell B, the method comprising:

applying a magnetic field to each memory cell and irradiating each memory cell with right-handed or left-handed polarized light to establish an energy state in which the total angular momentum of the entire

physical system ensemble forming each memory cell has a particular value;

simultaneously irradiating only the two memory cells A and B with one laser beam, detecting a polarization state of the laser beam transmitted through both memory cells, and generating entanglement for the memory cells A and B; and

simultaneously irradiating only the two memory cells A and V with one laser beam, detecting a polarization state of the laser beam transmitted through both memory cells, and teleporting the quantum state of the memory cell V to the memory cell B in which the entanglement with the memory cell A has been generated.

11. The method according to claim 10, wherein the memory cell is formed of a physical system ensemble distributed in a part of a space where an ensemble angular momentum is generated by selectively irradiating a spatially continuously and uniformly distributed substance with light, and the substance contains memory cells.

12. The method according to claim 10, wherein the physical system ensemble consists of gas atoms.

13. The method according to claim 10, wherein the physical system ensemble consists of rare earth ions in a solid.

14. The method according to claim 10, comprising

detecting cosine and sine components of a polarization state of the laser beam transmitted through the two memory cells at an angular frequency of Larmor precession with a homodyne detector.

15. The method according to claim 10, wherein the memory cells are arranged on a same plane at vertices and at a center of a regular polygon having an odd number of vertices, and wherein the memory cell arranged at the center of the regular polygon is used as the transfer memory cell and the memory cells arranged at the vertices of the regular polygon are used as the storage memory cells.

16. The method according to claim 10, wherein the memory cells are arranged on a same circumference, and wherein a memory cell is used as the transfer memory cell and the other memory cells are used as the storage memory cells.

17. The quantum memory according to claim 1, wherein the storage memory cells are arranged on a same straight line, and wherein the transfer memory cell is arranged on a position off the straight line.